Date: 2/16/10

Title: Permutations and Combinations

Objective:
To to determine the number of possible combinations in a set when order matters.

In:
What does 8! mean?

What does 8! equal?

In English we use the word "combination" loosely, without thinking if the order of things is important. In other words:

"My fruit salad is a combination of apples, grapes and bananas"

We don't care what order the fruits are in, they could also be "bananas, grapes and apples" or "grapes, apples and bananas", its the same fruit salad.

"The combination to the safe was 4-7-2".

Now we do care about the order. "7-2-4" would not work, nor would "2-4-7".
It has to be exactly 4-7-2.

If the order doesn't matter, it is a Combination.

If the order does matter it is a Permutation.

So, we should really call this a "Permutation Lock"!

W2L:

The difference between combinations and permutations is...

Eight men have the chance of winning a gold medal at the Olympic Games.

Does order matter?

In how many ways can this group of eight receive medals?

1: Alfonso
2: Bob
3: Charlie
4: Davon
5: Emilio
6: Frank
7: George
8: Horatio

1: Alfonso
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A B C D E F G H 8 choices

B C D E F G H 7 choices

C D E F G H 6 choices

Gold medal: 8 choices:
A B C D E F G H
Silver medal: 7 choices:
B C D E F G H.
Bronze medal: 6 choices:
C D E F G H.

We had 8 choices at first, then 7, then 6.
The total number of options was
8 * 7 * 6 = 336.

We know the factorial is:
8 * 7 * 6 * 5 * 4 * 3 * 2 * 1

Unfortunately, that does too much!
We only want 8 * 7 * 6.

How can we “stop” the factorial at 5?

This is where permutations get cool:

Notice how we want to get rid of 5*4*3*2*1?

What's another name for this? 5 factorial!

So, if we do 8!/5! we get:

$$\frac{8!}{5!} = \frac{8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}{5 \cdot 4 \cdot 3 \cdot 2 \cdot 1} = 8 \cdot 7 \cdot 6$$

$$\frac{8!}{5!} = \frac{8 \cdot 7 \cdot 6 \cdot 5 \cdot 4 \cdot 3 \cdot 2 \cdot 1}{5 \cdot 4 \cdot 3 \cdot 2 \cdot 1} = 8 \cdot 7 \cdot 6$$

$$\frac{8!}{(8-3)!}$$ is just a fancy way of saying

"Use the first 3 numbers of 8!".

$$\frac{8!}{(8-3)!}$$

"Use the first 3 numbers of 8!".

If we have ***n*** items total and want to pick ***k*** in a certain order, we get:

$$P(n,k) = \frac{n!}{(n-k)!}$$

Your band has written 12 songs and plans to record 9 of them for a CD.

In how many ways can you arrange the songs on the CD?

Permutations

Find the number of ways to arrange <u>AWEST</u>:

a) All the letters

b) Just two of the letters.

There is a calculator shortcut

P stands for permutation

$$_nP_r = \frac{n!}{(n-r)!}$$

Lets look at the letters in the word Awest again. If we want to use all of the letters, n would be __and r would be __.

Step 1: type the number 5

Step 2: hit the math button

Step 3: scroll to the right until you get to PRB

Step 4: Scroll down to $_nP_r$ and hit enter

Step 5: type the number 5 and hit enter

Out:

From a menu of 6 dessert items, you choose your top two desserts in ORDER.

Summary:

Compare and contrast permutations and combinations.